but has additional wheat tolerance. Pentafluoroethyl reduces activity notably.

3.1.3 Combining fluorinated benzenesulfonamide with difluoromethyltriazine (Fig 8)

After variation of the heterocyclic moiety from trifluoromethylpyrimidine to difluoromethyltriazine, trifluoromethyl as side chain on the benzenesulfonamide again leads to more active compounds than difluoromethyl. Both show good wheat selectivity.

3.1.4 Influence of new triazine substituents: $CCIF_2$ vs CF_3 (Fig 9)

However, chlorodifluoromethyl- and trifluoromethyltriazine are different, in that each combines better with an aromatic ester than with the fluorinated side chain. Selectivity in wheat is common to all.

4 CONCLUSION

Side-chain-fluorinated pyrimidines, triazines and benzenesulfonamides are ideal building blocks for the research chemist. They offer chemical and biological flexibility for new sulfonylureas as post-emergence herbicides. Selectivity in wheat and cotton is observed, best herbicidal activity being obtained up to the three- to four-leaf stage of the weeds. Selected compounds are undergoing broad field tests in wheat.

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Semiochemical modulation of oviposition behaviour in the gregarious desert locust *Schistocerca gregaria*

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Abstract: Bioassays have shown that sand freshly contaminated by ovipositing females of the gregarious desert locust *Schistocerca gregaria* (Forskal) is more effective in inducing further oviposition from conspecifics than contaminated sand stored for three or six months, which contrasts with results obtained previously with *Locusta migratoria* (Reiche & Farmaire). The activity of contaminated sand correlated with the levels of three unsaturated aliphatic ketones, (*Z*)-6-octen-2-one, (*E,E*)-3,5-octadien-2-one and its geometric isomer (*E,Z*)-3,5-octadien-2-one present in the volatile emissions from the sand.

Keywords: *Schistocerca gregaria*; (*Z*)-6-octen-2-one; (*E,E*)-3,5-octadien-2-one; (*E,Z*)-3,5-octadien-2-one; oviposition; seimiochemical; locust

Gregarious females of the desert locust *Schistocerca gregaria* (Forskal) and *Locusta migratoria* (Reiche & Farmaire) produce pheromones during oviposition which attract conspecifics to lay their eggpods at common sites.[1–4] In *L migratoria*, repeated layings by females increase the preference of the sand for further oviposition.[3,4] Of the two locust species, pheromone identification has been carried out for *S gregaria* in recent work from our laboratory. Two aromatic compounds, acetophenone and veratrole were identified from the volatiles emitted by the froth plug of the eggpod as oviposition pheromone components.[5,6] In the present study, the oviposition response of females of *S gregaria* to sand in which conspecifics had laid previously, but without the froth or eggs, was compared to that of clean sand. On average, about 75% of the eggpods deposited by females were laid into moist sand contaminated by conspecifics compared to 25% into clean moist sand. However, much of the activity of contaminated sand was lost after long storage at room temperature, dropping to 56% after three months, with a total loss of activity after six months. These results contrast with those obtained previously for *L migratoria* for which the activity of contaminated sand can last for as long as six months.[4] Gas chromatographic-electroantennographic detection (GC-EAD) analysis revealed the presence of three candidate oviposition pheromone components in the volatiles of freshly contaminated sand. These were identified by GC-MS as (*Z*)-6-octen-2-one, (*E,E*)-3,5-

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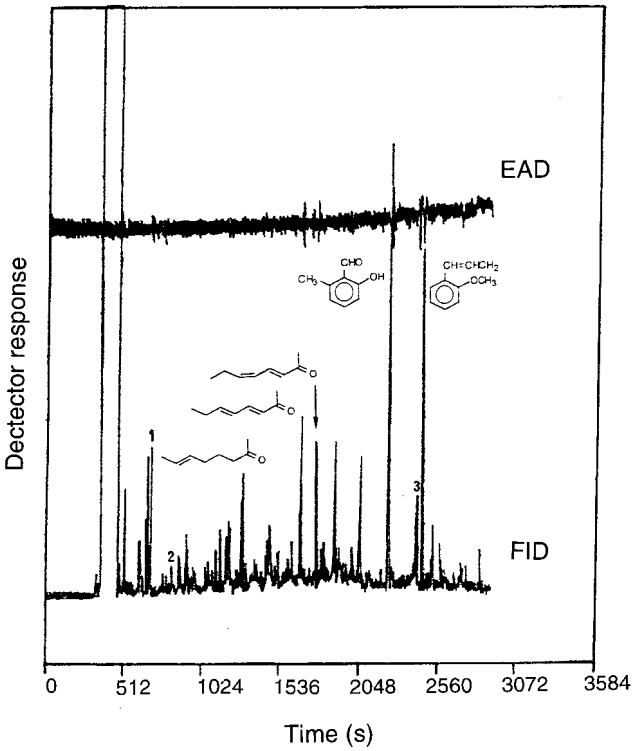

Figure 1. Representative reconstructed computer GC-EAD recordings of adult female *S gregaria* antennae, responding strongly to (*Z*)-6-octen-2-one, (*E,E*)-3,5-octadien-2-one, (*E,Z*)-3,5-octadien-2-one, 2-hydroxy-6-methylbenzaldehyde, 2-methoxy-1-propenyl-benzene and the unidentified compounds **1–3** in the crude volatile extract of three-month-old contaminated sand. Only the three unsaturated ketones evoke antennal responses in the volatile emissions of freshly contaminated sand.

octadien-2-one and its geometric isomer (*E,Z*)-3,5-octadien-2-one. Unlike acetophenone and veratrole, these compounds were traced to volatile emissions from the eggs. Analysis of volatiles from the sand stored for three months showed relatively lower levels of the three unsaturated ketones identified previously, compared to those present in freshly contaminated sand, which may account for the drop in activity of this sand. In addition, 14 other compounds which evoked antennal responses from adult females of *S gregaria* were detected. Of these, 2-hydroxy-6-methylbenzaldehyde, 2-methoxy-1-propenyl-benzene and three unidentified components (**1,2,3** Fig 1) evoked the strongest responses. Only trace amounts of the three unsaturated ketones were detected in the volatile emissions from the six-month-old sand which correlates with lack of activity of the sand. The results suggest that the aromatic compounds detected in EAG recordings in the volatiles of aged contaminated sand play no role in oviposition-site selection by gregarious females of *S gregaria*.

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Chemical interactions with the herbicide propanil on propanil-resistant barnyardgrass

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Abstract: We are examining the interaction of compounds with the herbicide propanil to find synergistic or additive actions that can increase efficacy against propanil-resistant barnyardgrass [*Echinochloa crus-galli*] (R-BYG) without substantial injury to rice. Field tests (herbicidal injury) and laboratory tests (chlorophyll quantification in excised leaves; measurement of chlorophyll fluorescence to determine PSII inhibition) have been conducted on R-BYG and rice tissue exposed to various rates of propanil and additive. Important synergistic interactions on R-BYG in laboratory and field tests were found with propanil plus either the herbicides anilophos or piperophos, or the insecticide carbaryl. In laboratory tests, the insecticide methiocarb and PPG-124 (*p*-chlorophenyl *N*-methylcarbamate) were highly effective synergists with propanil on R-BYG. Other important interactions occurred with certain concentrations/application rates when propanil was combined with the herbicides quinclorac, thiobencarb, molinate, or pendimethalin (field tests). Combinations of these or other chemicals with propanil may provide additive or synergistic action useful to control R-BYG without increasing rice injury. Such mixtures might also prevent or delay the development of propanil resistance in this weed species.

Keywords: aryl acylamidase; chlorophyll fluorescence; *Echinochloa crus-galli*; insecticide; photosystem II inhibition; synergism

1 INTRODUCTION

The amide herbicide propanil [3′,4′-dichloropropionanilide], a photosystem II (PSII) inhibitor, is the principal herbicide used to control broadleaf and grass weeds, including barnyardgrass (*Echinochloa crus-galli*

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